ENHANCED GENERAL AVIATION DECISION MAKING: WEATHER ASSESSMENT DURING PREFLIGHT PLANNING

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This report discusses strategies that may be used by pilots to enhance weather decisions during general aviation preflight planning. Current classroom decision training is primarily based on outdated theory as well as anecdotal evidence. More recent research completed in field settings hold important implications for improved training. Here we blend information from current research and theory in human learning, memory, decision making and expertise and apply it to database information, expert opinion, and a look at what is lacking in current training curriculums.

INTRODUCTION

In ground training the pilot learns about aeronautical theories and concepts such as aircraft systems, basic meteorology, weather data interpretation, etc. This basic knowledge is critical toward an ability to move to the next step, which is to apply these concepts and practice basic flying skills. These basic flying skills must be practiced repetitively1 in order to acquire the proficiency necessary to safely control the aircraft. This repetition does lead to learning, however, this learning is not geared toward handling the complexities, the fluidness, of decisions required to expertly pilot an aircraft. Typical training can be inadequate towards these higher-level decisions that will be encountered during all phases of flight. Flying is done in often uncertain, dynamic situations that can include a range of meteorological phenomenon. Pre-flight and in-flight decisions about a course of action are made based on a complex integration of the pilot's experience, weather information from a range of sources, the need to reach a destination, time pressure, personal attitude, human psychological tendencies, etc.

The purpose of this paper is to introduce strategies that will be integrated into aeronautical decision-making training products that are based on current theory and published empirical research. In this report we focus on critical decisions made during the preflight phase.

METHODS

Safety risk identification

We will present a prototype-training product in September 2005. So that this product provides maximum impact toward aviation safety we are constraining the training to high-risk issues. Three methods were used to identify these top issues.

(1) For six months, we participated in bi-weekly discussions with general aviation weather decision domain experts. The results of these discussions confirmed the data obtained from the second method. (2) Lists of 83 search terms (e.g., "VFR flight into IMC", "decision-making,", etc.) were used to conduct a search of the ASRS database. The search was conducted for reports filed by general aviation (GA) pilots between January 1995 to January 2005. Over 500 reports were identified and 68 reports were found to be relevant to this project. (3) Data published in the 2004 Nall Report, which summarizes NTSB accidents, also support our ASRS conclusions.

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The result of applying recent research and theory to the focused issues identified using these three methods will now be addressed in the context of preflight planning.

RESULTS

Assessment of the 68 ASRS reports revealed three prominent findings: poor weather assessment, overestimating piloting capabilities and, distractions leading to aircraft upset (this last finding relates to poor instrument scan when the pilot is distracted by such things as struggling with spatial disorientation, unexpected poor aircraft performance, or difficulty with GPS programming). Here our focus will be on poor weather assessment, which was identified as a major recurring issue arising in 34 of the 68 ASRS general aviation reports.

Specifically pilots either did not obtain adequate weather information and were taken off guard, they did not adequately interpret the weather information, or they underestimated the danger of entering a cloud (because this is an en route topic, it will be discussed in a later publication).

During preflight pilots sometimes choose not to call a Flight Service weather briefer. There appears to be a number of reasons as to why this happens. For example, the pilot has get-there-it-is and rushes through the preflight. Other pilots find it unnecessary to call altogether because the weather appears acceptable just by looking outside or flight route familiarity. Sometimes pilots simply forget to call flight service do to distractions during preflight such as peer pressure or aircraft rental implications. Pilots sometimes decide to rely on automated weather reporting systems instead, such as AWOS for cloud/ceiling and visibility information during their preflight planning, or choose to depart when VFR is not recommended by flight service. Because Flight Service typically errs on the conservative side some pilots may disregard their advisory. This conservatism indicates that current or forecasted weather conditions may be at or below VFR weather minimums and the pilot should investigate why this advisory was provided.

DISCUSSION

We propose that if an enhanced understanding of the weather situation had been obtained during preflight, many of these incidents could have been avoided.

Strategies that may be used to better assess the weather are to

- Learn how to recognize typicality, and therefore anomalies,
- Mentally simulate a course of action,
- Prioritize cues,
- Develop expectancies.

We will now discuss how to implement these strategies.

When first introduced to piloting, novices improve performance for a period of time until reaching an average level of performance, at which point performance remains relatively stable. The striking difference between expert and average performance seems to result not just from how long the pilot has had his piloting license or even how many hours he has logged, but on the quality of the training received, deliberate practice in simulated environments, the particular types of flying experiences that he has encountered, and whether he considers piloting fun.[2]

Novice and expert pilots fly in different worlds. The novice is involved in the moment, such as being distracted with

trimming the aircraft, whereas the expert pilot controlling the aircraft is routine and therefore able to constantly assess the overall situation, such as if the actual weather agrees with the forecasted weather. If the novice or intermediate pilot can master a broader, holistic, view of flying, then they may better recognize potential problems and find solutions before meeting a hazardous condition head-on.

Taking a broader view starts with a well-laid flight plan. Developing a detailed flight plan helps the pilot to get mentally in 'the game' by providing him with the big picture. To develop a flight plan the pilot must pull together different resources which forces him to think broadly, to become more familiar with every aspect of the flight leading to more informed in-flight decisions, and to better manage his workload during flight.

A large part of preflight planning includes gathering and interpreting weather information. What sources of weather information should a pilot use for preflight planning? While weather reports on the television are an easy way to keep an eye on the big picture, they cater to weather relevant to people on the ground. Preflight planning should include the use of Internet aviation weather services; such as the prognostic charts, satellite images, text reports and forecasts. The combination of this information from these sources will provide a clearer understanding of an extensive weather product such as an Area Forecast (FA). In a current multi-agency effort entitled the Next Generation Air Transportation System (NGATS) the plan is to develop automated capabilities to integrate weather information for the pilot. However, until a considerably deeper understanding of how to automate decisions in uncertain, dynamic environments is attained, the pilot must continue to be the authority on whether he should continue with his flight.

Because there are numerous sources of weather information that present the data in different formats it is imperative to know what information from which weather product is relevant and how to apply it to the current flight. Expert pilots can extract the relevant information to make a rapid [3-7], acceptable (rather than best) [8- 10] decisions. How can novices possibly learn this experience-based ability? To answer this question, we will examine common difficulties pilots face in interpreting the weather.

Meteorological conditions are complex and constantly changing. When a pilot is planning a flight and the weather information is ambiguous, a change of plan may be difficult to justify. This can result in a common error made in piloting called a "plan continuation error"[11]. One strategy used by expert pilots that may reduce the ambiguity of the weather information is to take the time to address any uncertainties about that particular, unique flight. The expert pilot will call back the Flight Service Station (FSS) to ask questions that clarify the ambiguity. ASRS reports show that less experienced pilots may choose not to be assertive because it makes them feel uncomfortable. However, if an expert pilot still does not understand the weather picture, they dig deeper sometimes going to the source - the National Weather Service (NWS). You can get the NWS phone number from FSS or in your Airport/Facility Directory (AFD).

Pictures are much better remembered than words.[12] A pilot may feel bombarded by weather information, for example, the Flight Service Briefer may rapidly speak an Area Forecast (FA). To process and remember this information particularly if the pilot does not have access to a computer, he may draw the FA either on the sectional chart or on a

photocopy of an area map (there are charts in the AIM (Aeronautical Information Manual), such as the geographical area designation map in which FA's are often related to). If information about the direction and speed that a system is moving is also drawn onto the map it may help with potential decisions related to choosing an alternate airport.

At times a pilot may be aware of cues in a weather report that suggest the flight should be postponed, but they choose to take-off nonetheless. There are at least three identified reasons for this risky behavior. First, the pilot may have underestimated the level of risk. [13] Here it is suggested that the level of risk may be more clearly seen by imagining, while still on the ground, different scenarios of how the weather may progress, or change, making it less likely that the pilot will be surprised.

A second identified reason that pilots might fly into bad weather is that the pilot may lack the relevant experience and therefore do not recognize a cue as a risk. [14] One strategy that may hasten experience level is for the pilot to observe the weather everyday, all day, even if he is not flying that day. Whenever the pilot looks out the window, or when he goes outside, he should take a look at the clouds. What are they doing today? Why are the clouds shaped as they are? Why is their altitude changing? Finding answers to these questions is good practice, because when it comes time to fly, one of the skills that every pilot should have is to be able to 'read' the clouds. Cloud shape, color and thickness, and altitude can be used as weather indicators. As this skill improves the pilot will begin to correlate the temperature, dew point, humidity, and time of day to the types of clouds that have formed. Also, the expert pilot takes notice of the wind and imagines the conditions visually in his mind. For example, he visualizes how the wind wraps around the tree or whips around the corner of a building. This technique can be helpful during take-off or landing – an unexpected gust of wind won't be so unexpected. By honing in on these skills the novice pilot will have a better understanding of the big weather picture and the cues to watch for before he walks into the Fixed Base Operator (FBO) and calls Flight Service.

A third reason that pilots sometimes fly into bad weather is that they may be committing what is called "frequency gambling" [15-17] which refers to expecting to succeed using a behavior that previously succeeded in a similar risky situation. Even if a pilot simply observes another pilot succeed can lead him into frequency gambling. For example, ASRS #615534 reported a pilot who encountered an unusual attitude immediately after take off. The pilot was motivated to do the fight because he had a meeting to attend. The weather was reported as poor but the pilot thought that he could take off and then look at the weather to make his go/no go decision since he had observed this practice many times when flying with another pilot. He took off and went immediately into the clouds. The pilot panicked and became disoriented. He stalled the airplane, recovered, then entered a steep spiral at a low altitude.

The strategies above may help make the pilot more knowledgeable about the weather. Greater knowledge will lead to greater confidence and better responses when confronted with a weather situation.

CONCLUSION

The complexity of aeronautical decisions cannot be overstated. To train enhanced aeronautical decision-making (EADM), theory and knowledge from a variety of sources is imperative. Here we blend information from current research and

theory in human learning, memory, decision making and expertise and apply it to database information, expert opinion, and a look at what is lacking in current training curriculum. These strategies are a part of an enhanced aeronautical decision making training tool being developed in the Beard laboratory. A prototype of this product will be available September 2005.

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